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VOL. XXIX. APRIL 1922 No. 2

MICROSANIA, A GENUS OF THE PLATYPEZIDAE[1]

By A. L. Melander,
Pullman, Wash.

Microsania Zetterstedt, Isis, 1837, i. 30 [1837];
Ins. Lapp. 534, note [1838];
Dipt. Sc. i. 333 [1842];
Bigot, Ann. Soc. Ent. Fr. [6] ix. 123 [1889];
Melander, Williston's 3d. Man. 225 [1908];
Lundbeck, Dipt. Dan. Emp. iii. 18 [1910];
Wahlgren, Ent. Tidskr. xxxi. 43, 47 [1910]

Microcyrta Bigot.
Bigot, Ann. Soc. Ent. Fr. [3] v. 557, 564 [1857]; Coquillett, Proc. Ent. Soc. Wash. v. 253 [1903];
Pachypeza Lioy, not Serville, Coleoptera, 1835; Lioy, Atti. Inst. Veneto [3] ix. 723 [1863]; Coquillett, Proc. Ent. Soc. Wash. v. 255 [1903].
Platytelma Rondani.
Rondani, Dipt. Ital. Prodr. i. 138 [1856]; Coquillett, Proc. Ent. Soc. Wash. v. 256, 261 [1903].

Small, hunchbacked species with open venation and inflexed hypopygium. Head rather globular, eyes bare, of the male entirely contiguous above the antennæ, the facets of the upper two-thirds large, of the female broadly separated, the facets uniform, the front of the female with one pair of vertical and two pairs of orbital bristles, the lower pair converging, and a pair of diverging supraantennal interfrontal bristles; face of the male deeply concave, its sides divergent below, of the female strongly convex below, almost nasiform; proboscis fleshy, short, not extending beyond the broad oral cavity, palpi very wide, disciform and appressed against the cheeks; occipital hairs sparse but stiff; antennæ short, basal joints small, the third joint orbicular, with a terminal tapering arista at whose base are two minute segments. Chaetotaxy of the thorax as follows: one humeral, two or more posthumeral, four to six notopleural

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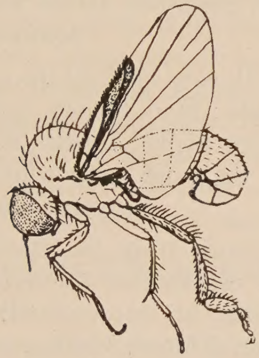
[1] Joint contribution from the Bussey Institution of Harvard University No. 150, and the Zoology Laboratory of the State College of Washington.

arising as an oblique row, several supraalar, one postalar, four scutellar, about ten dorsocentral and a single median row of acrostichal bristles; pleuræ entirely bare. Abdomen cylindrical but curving downward in the male, the hairs of the male long; the eighth segment of the female retracted and blunt, the basal three ventral segments of the male inflated, the sixth and seventh segments forming a stout pedicel to the large globose inflexed hypopygium which bends forward under the abdomen. The hypopygium is bilaterally symmetrical and terminates in a pair of small bristly ovate valves and a subdorsal median prong. Legs rather short, the middle tibiæ with an apical flexor bristle, hind femora pectinate above, hind tibiæ somewhat compressed clavate, pectinate on the extensor edge, the posterior side tomentose like the swollen metatarsus. Wings very broad at the base, the anal angle very full and rectangular, costa abruptly thinned at the end of the first vein, two basal bristles present and also numerous costal setulæ but no hairs, auxiliary and first veins strong, the other veins very weak and almost straight and radiating, stigma very prominent and so sharply limited behind as to present an extra vein between the first and second veins, the second vein ending near the tip of the wing, anterior crossvein wanting, a terminal spur of the anterior fork of the fourth vein present, discal cell open, only a trace of the crossvein at the end of the minute second basal cell, anal cell short and apically acute, alula well developed and margined with long flattened scale-like hairs. Type species, *M. stigmaticalis* Zetterstedt.

The genus *Microsania* includes very small, inconspicuous flies that are rarely observed by the general collector. Because of a superficial resemblance in the open venation to the species of *Bicellaria* (*Cyrtoma*) previous authors have been led to locate the genus in the Empididæ. A close inspection discloses that the resemblance gives way to far more significant differences, and that *Microsania* is not an empid but is closely related to *Platycnema* and *Opetia*, forming with them a group of the Platypezidæ characterized by an open discal cell and by the presence of a distinct humeral bristle. *Microsania* differs from *Platycnema* and *Opetia* in lacking the anterior crossvein and in having a heavily thickened stigma formed about the shortened first vein.

Microsania departs from all empid genera in possessing a large and inflexed hypopygium and a single median row of acrostichal hairs. The anal crossvein continues toward the hind margin of the wing forming a pointed anal cell and this important phyletic character thus suggests the Hybotinæ. *Microsania* differs from all the members of this subfamily in the interrupted setulose costa, open venation and short fleshy proboscis, and shows no evident relationship to this group.



Microsania pectipennis Meig.
Male x 20.

The platypezid traits of *Microsania* are as follows: The antennal excision of the eye is no stronger than in *Opetia;* strong interfrontal bristles are present; the arista has two basal joints; the proboscis is short and fleshy; the notopleural suture is very short and above it is a vertical row of notopleural bristles; posthumeral bristles are present; the middle tibiæ have strong apical bristles; the hind tarsi are large, compressed and sericate within; the pedicel of the second and third veins is long, and a distinct alula is visible. Such differences as the large broad palpi, swollen clypeus of the female, more bristly thorax, rounder coxæ and pectinate hind legs, and short bristly costa and open neuration are no more empidine than platypezine.

Three species of *Microsania* are known: *pallipes*, with light colored legs; *stigmaticalis*, with minute costal setulæ; and *pecti-*

pennis, with longer costal setulæ. All three occur in Europe, the last two are here recorded also from America, where *stigmaticalis* has been previously known under the name of *Platycnema imperfecta* Loew. The two American species are separable on the following characters:

First section of the costa with evident setulæ, second section with more than ten setulæ; hind femora pectinate above with long bristles, hind metatarsi setose above; bristles black; 2-2.25 mm. *pectipennis* Meigen.

First section of the costa with very weak setulæ, second section with less than ten setulæ; hind femora short-pectinate, hind metatarsi not setose above; bristles at least of the lower occiput and of the front coxæ whitish; 1-2 mm. *stigmaticalis* Zetterstedt.

I have specimens of *pectipennis* from the Pacific slope, its range indicating a continuous distribution through to northern Europe. The following localities are represented: Yellowstone Park, Wyoming; Bovill, Coeur d'Alene, Collins, and Potlatch, Idaho; Olga, Pullman, Spokane, Tacoma and Woodland, Washington; Douglas, Alaska; and Eureka, California.

M. stigmaticalis, as *P. imperfecta*, was described from the District of Columbia. There are no further records of its occurence in America. I have specimens from the following widely separated localities, which have been compared with Dr. Loew's type of *imperfecta*, now located in the Agassiz Museum of Harvard University, and with European specimens of *stigmaticalis*. Boston, Massachussetts; Cold Spring Harbor and Ithaca, New York; Philadelphia, Pennsylvania; Washington, D. C.; St. Augustine, Florida; Paris, Texas; Chicago, Illinois; Brookings, South Dakota; Lawrence, Kansas; Thompson, Montana; Coeur d'Alene and Potlatch, Idaho; Colfax, Friday Harbor, Index, Mount Rainier, Pullman and Quilcene, Washington; Nelson, British Columbia; and Panama.

Males of both species have been taken in a light trap at night. Most of the females were caught on windows in houses, a habit originally noted by Zetterstedt. On several occasions the species have been found running about on a tent while in camp in the woods. Quite a few of the specimens are heavily parasitized by mites, of which several species are distinguishable, clustering on the underside of the abdomen.

Summary.

The genus *Microsania*, hitherto assigned to the Empididæ, belongs to the Platypezidæ. There exist in America two species, idential with two of the three European species. One of these, *M. stigmaticalis*, has previously been known from North America only through its original finding which was recorded under the name of *Platycnema imperfecta*. The genus is widely distributed from Alaska to Florida and Central America and apparently from its prevalence in Northern Europe and the mountainous districts of Western America has a circumpolar range.

Bibliography of the Species of Microsania.

pallipes Meigen. C. Europe

Meigen, Syst. Bes. vi. 356 (1830) *Cyrtoma*
Macquart, Hist. Nat. Dipt. i. 360 (1834) *Cyrtoma*
Rondani, Dipt. Ital. Prodr. i. 138 (1856) *Platytelma*
Bigot, Ann. Soc. Ent. Fr. (3) v. 557 and 564 (1857) *Microcyrta*
Schiner, F. A. Dipt. i. 76 (1862) *Cyrtoma*
Lioy, Atti. Inst. Ven. (3) ix. 723 (1863) *Pachypeza*

pectipennis Meigen C. and N. Europe; W. N. America

Meigen, Syst. Bes. vi. 356, pl. lxvi. f. 15, 16 (1830) *Cyrtoma*
Zetterstedt, Dipt. Sc. i. 335 (1842) *pectinipennis;* viii. 3013 (1849) *pectinipes*
Wahlgren, Ent. Tidskr. xxxi. 47 (1910) *pectinipennis*

stigmaticalis Zetterstedt N. Europe; and N. and Cent. America.

Zetterstedt, Lapp. 534 (1838) *Cyrtoma*
Dipt. Sc. i. 334 (1842); viii. 3013 (1849); xiii. 4998 (1859);
Bonsdorff, Finl. tv. Ins. i. 157 (1861)
Lundbeck, Dipt. Dan. iii. 19, f. 3 (1910);

Wahlgren, Ent. Tidskr. xxxi. 47, f. 3 (1910);
Frey, Acta Fenn. xxxvii. (3) 8 (1913)

imperfecta Loew
Loew, Berl. Ent. Zts. ix. Cent. vi. 82 (1865) *Platycnema*
Aldrich, Cat. Dipt. 342 (1905) ? *Platycnema.*

NOTES ON THE BIOLOGY OF CERTAIN WASPS OF THE GENUS ANCISTROCERUS (EUMENIDÆ)[1]

By Leland H. Taylor.

During the summer of 1921, while attempting to get some material for the study of the biology of the Chrysididæ, I was able to make some fragmentary observations on three species of Eumenidæ which I present here.

The biology of various species of Eumenids has received much attention from both European and American observers, whose work cannot be reviewed in this paper. Particular mention should be made of the observations of Fabre (1882, 1884, 1891), Ferton (1895, 1901-1921) and Roubaud (1916) among Europeans, and of the studies of such American workers as the Peckhams (1900, 1905), Hartman (1905), Hungerford and Williams (1912), Isley (1913) and the Raus (1918). With the exception of *Ancistrocerus capra* de Saussure, the species of Eumenidæ treated in this paper have not been studied, and it is hoped that these notes, if presenting nothing particularly new, will help to confirm previous observations on this highly interesting group.

The species which I have been permitted to observe are apparently those which are usually accustomed to nesting in suitable cracks and crevices of stone and wooden walls. Under ordinary circumstances, therefore, their workings are practically inaccessible, but by the use of artificial nesting places[2] it has been possible to keep in close touch with the operations of nest construction and also to observe the development of egg, larva and pupa.

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[1] Contributions from the Entomological Laboratory of the Bussey Institution, Harvard University. No. 198.

[2] Both solitary wasps and bees have been induced by other investigators to nidificate in tubes of glass. See the papers of Fabre (1884) and Bordage (1912).

About the middle of June sixty artificial nesting places were put out on the window sills and in other situations near the walls of the Bussey Institution where Eumenids had been noticed searching for places in which to nidificate. These nesting places were crudely and variously constructed, all, however, consisting of glass tubes inserted in holes bored in blocks of wood. A type of the apparatus used is shown in figure 1; others were more simple, but all were so constructed that the tube could be expeditiously removed and replaced. It was found by trial that tubes having an inside diameter of from six to eight millimeters were preferred by the wasps. Individuals repeatedly entered and examined tubes of greater diameter, but in no instance did they make use of them.

That these tubes were acceptable to the wasps is shown by the fact that no less than three started their building within the first three days after the tubes were placed out, one nest having been entirely completed during that time. The device proved to be convenient for the study of the occupants but for two disadvantages. First, the condensation of moisture on the inside of the glass tubes sometimes caused the egg or young larva to adhere to the walls so that it was prevented from reaching its food. The moisture also accelerated bacterial infection which in some cases destroyed both egg or larva and provisions. Second, the activities of the larva after the spinning of the cocoon could not be well observed without breaking the tube.

I wish to thank Doctor Joseph Bequaert of the American Museum of Natural History who has very kindly determined the species of Ancistrocerus mentioned in this paper.

Ancistrocerus tardinotus Bequaert MS.

This species of Ancistrocerus is treated in detail, as I had the opportunity to observe rather closely the nest-building activities of two females. It will also serve as a type of the work done by other Eumenids which came to my notice.

Nest No. 2.[3] Scarcely 24 hours had passed after the tubes had been placed out, when a wasp was seen (June 13) entering one of them carrying mud or gravel which she got at a driveway 25 feet distant. Between each trip for gravel, which always took several minutes, she took a shorter flight which I could not follow, probably to her water supply. She continued in this way from four until five o'clock P. M., when I was obliged to leave. At six P. M. she entered her nest carrying beneath her body a small green caterpillar, which she quickly deposited, then flew away. Between six and seven o'clock she made about six or seven visits to her nest, each time bearing a similar caterpillar. One of her absences from the nest was of only two or three minutes duration, but usually she did not meet with such prompt success. She spent no more time within the nest than would allow her to deposit her prey. From this time on I observed her only sufficiently to state that she worked quite consistently for the next two days and completed her nest at some time just previous to four P. M. on June 15.

Nest No. 3. On June 16 at four P. M. a wasp of this species, possibly the same one as described above, was seen to enter one of the nesting places not far from nest No. 2. An examination of the tube at this time showed two cells already completed. Outside the closing partition of the second cell was a third egg and a single caterpillar. The wasp continued to work until seven P. M. at which time she had nearly completed the closure of her third cell. During the night she did not occupy the nest as these wasps commonly do, possibly because there was hardly sufficient room. Indeed, it seemed that she would not be able to construct an additional cell in such a limited space. Observations at 5:30 and at 7:30 the next morning showed that the wasp had not resumed her work, but by 8:30 she had already finished the closing partition of the third cell and had laid her fourth egg. During the morning she caught and deposited three caterpillars and at 10:45 she brought the bit of cement that would have closed the last cell had I not captured her for identification before she had been able to apply it.

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[3] The numbers designating the nests described in this paper are the original ones used in my field notes; they are thus not consecutive.

The two nests built by wasps of this species did not differ greatly from each other or from those constructed by the other wasps noted in this paper. Wasp No. 2 built her nest (Fig. 1) in a tube which had an inside diameter of 7.5 millimeters. It contained four cells whose respective lengths were as follows: cell No. 1[4], 14mm.; No. 2, 8 mm.; No. 3, 6 mm.; and No. 4, 5 mm. In each cell at about two millimeters from the inner wall was suspended from above by means of a fine thread about a millimeter in length a white, glistening egg. The egg, which resembled almost exactly eggs of other members of this genus which I have observed, was about 2.5 mm. long, subcylindrical, concave dorsally (?) and convex ventrally (?) (Fig. 3). In some cells it hung freely; in others, where the provisions were more tightly packed, it was pushed firmly against the upper wall of the cell. Cell No. 1 was provided with ten caterpillars, No. 2 with six, No. 3 with three and No. 4 also with three. The caterpillars were of uniform size, about 12 mm. long and all appeared to be of the same species, probably of the family Tortricidæ· They were imperfectly paralyzed and responded to mechanical stimulus by quick, jerky movements of the abdomen. The head and thorax, however, seemed little capable of movement, the mouth parts and legs scarcely responding to the touch. It would seem then that the sting of the wasp must be introduced in the region of the thorax, thus bringing about partial paralysis of the parts which might tend to injure the egg or young wasp.

The cells of the nest were separated by partitions one millimeter in thickness, constructed of earth of a fine clayey consistency and moistened with water (and perhaps secretions) to form a cement which at first had a brownish color but became gray after drying. The partitions were not laid with precision transversely in the tube, but were often irregular with a slight oblique tilt. The inner surfaces of the partitions appeared more rough than the outer surfaces, due to their having been smoothed out by the wasp's mandibles. In constructing these partitions the wasp first lays down the rim, flattening out her first lump of mud between the mandibles and adding further material concentrically within until only a minute opening remains. This she plugs with a small bit of mud and then apparently smooths out the surface of the whole. In the nest of wasp No. 2 a vacant space about 10 mm. long was left between the outermost occupied cell and the entrance.[5] The closure was flush with the surface of the entrance block; it was a plug of cement twice as thick as the partitions within and not smoothed off outwardly.

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[4] In designating the cells of a particular nest the numbers 1, 2, 3 etc. refer to the order in which the cells were constructed by the wasp. Thus the innermost cell is no. 1, the next, no. 2 and so on.

The nest of wasp No. 3 was made in a tube which differed slightly from that shown in the figure (Fig. 1) in that the outer end of the tube was flush with the entrance, there being no entrance block. In this nest the outermost cell reached the entrance of the nest, no empty space having been left by the wasp as in the former case. The glass tube had an inner diameter of only 5 mm. The wasp had adapted her construction to this smaller diameter by making the cells longer. The comparative lengths of the cells in this nest and the number of caterpillars provided in each were as follows: cell No. 1,-17 mm., 6 caterpillars; No. 2,-17 mm., 7 caterpillars; No. 3,-11 mm., 3 caterpillars; No. 4,-5.5 mm., 3 caterpillars. The caterpillars appeared to be of two species and perhaps represented two families (Pyralidæ and Tortricidæ?).

The following tabulation gives the life histories of the wasps in nests 2 and 3.

Nest No. 2.

Date of	*Cell No. 1* ♀	*Cell No. 2* ♂	*Cell No. 3* ♂	*Cell No. 4* ♂
Oviposition	June 13	June 14(?)	June 14(?)	June 15(?)
Hatching	June 16	June 17	June 17	June 18(?)
Cocoon spinning	*	June 23	June 23	June 23
Pupation	June 30	June 29(?)	June 29(?)	June 30
Imagination	July 13	July 9(?)	July 9 (?)	July 10(?)
Emergence	July 15	July 11	July 11	July 11
Death	Oct. 15	July 19	Oct. 15**	Aug. 17

*This wasp curiously spun no cocoon, only a few loose threads. It became inactive June 25.

**Death of this male may have been hastened by falling into the sirup, supplied as food.

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[5] According to Roubaud (1916) such empty cells are evidently for the purpose of confusing parasites.

Nest No. 3.

Date of	*Cell No. 1* ♀ (?)	*Cell No. 2* (?)	*Cell No. 3* ♂	*Cell No. 4* ♂
Oviposition	June 16(?)	June 16	June 16	June 17
Hatching	*	June 19(?)	June 19(?)	June 20
Cocoon spinning	....	**	June 24	June 25
Pupation	....	....	June 29	June 30
Imagination	....	....	July 10	July 10
Emergence	....	....	July 14	July 11***
Death	....	....	Oct. 6	Aug. 27

*Did not hatch.

**Died June 22.

***Emergence probably premature; cocoon broken open for observation.

The above tables give the following as the lengths of the stages in the life of *Ancistrocerus tardinotus*: egg, 3 days; larva, 10-14 days; pupa, 11-14 days. The larger figure for the larval and pupal stages represents the length of these stages in the single female which reached maturity, from the innermost cell of nest No. 2. The other five individuals which matured from these two nests were all males.

The eggs of this species, like those of other species noted here, show the first sign of hatching by a swelling of the chorion on one or both sides. This seems to be due to the flattening of the larva, the pleura becoming somewhat protuberant. (Fig. 4). The chorion then becomes ruptured at its anterior or lower end, and the minute larva by slow movements works about three-quarters of its body out. Thus suspended it remains for half or three-quarters of an hour during which time it appears to derive some nourishment through the integument of the caterpillars which it may be able to reach. Figure 5, sketched from an undetermined larva of Ancistrocerus illustrates the appearance of the larva in this position. Soon freeing itself from the chorion, the larva moves about actively, finally taking a position with its mouth closely applied to the integument of one of its caterpillars often just behind or near the thorax. At first it appears to feed without biting the skin of its prey and its feeding is indicated only by the rhythmic movement of its body, but as it increases in size it may be seen to bite rather ferociously at its caterpillar, sinking its mandibles and even its entire head into the now lacerated body. Growth is rapid and usually the food is consumed to the last bit, even the heads being eaten by some of the more voracious individuals. When all the food is gone the larva may be observed moving about its cell, its mandibles constantly working along the walls. Whether it is searching for more food or attempting to begin its cocoon is not entirely evident. At any rate, the result of this activity seems to be that all the detritus in the cell, including the excrement of the caterpillars and whatever of the food supply may occasionally remain uneaten, becomes gathered at one end or along the lower wall of the cell, so that it does not interfere with the spinning of the cocoon. Before actually spinning the cocoon the Ancistrocerus larva makes a rather coarse-meshed network closely applied to the walls of the cell, entirely lining it and excluding all debris. The cocoon is variable in shape, irregularly cylindric-elliptical with one of its ends and its lower surface touching the walls of the cell, usually at the inner and lower end. It is tough, closely woven, translucent and semi-transparent, usually of a pale brownish tint with a slight silky lustre. Figure 2, though perhaps of a different species, illustrates the position of these cocoons *in situ*. Pupation does not take place immediately, the larva remaining quiescent in the cell for from five to seven days.

As in most nidificating Hymenoptera which construct similar nests, the outermost occupant of the nest is the first to emerge, though it is necessarily the product of the most recent egg laid by the builder. All the males reach the adult stage at about the same time, but until the one nearest the entrance makes its escape, there appears to be no attempt on the part of the others to break out, though they often may have already broken from their cocoons and are free to emerge as soon as the way is clear. Once the first male has made its escape the others follow in rapid succession, the females only remaining after the males have been gone for some little time.

In the species of Ancistrocerus which have come to my notice, the wasps which have developed from the innermost cells of a nest have been invariably females. These inner cells are always of greater capacity and more bountifully provisioned than the smaller, outer cells, which are destined to give forth males[6]. In a very painstaking study Fabre (1884) found a similar distribution of the sexes in the nests of certain solitary wasps and bees. Later Verhoeff (1892a, 1892b) made like observations and gave the name *proterothesie* to this phenomenon. Bordage (1912) and Roubaud (1916) have found it also in solitary wasps of the Malagasy and Ethiopian regions. This disposition of the males and females is supposed by authors to permit the males on emerging to fly about and thus come in contact with females from other nests, achieving cross-fertilization. In one of the nests which I had in confinement, however, (nest no. 2) one of the first two emerging males constantly sat at the entrance of the nest from which it had just escaped, apparently waiting for a female. The next wasp to emerge was another male; the new arrival was met with palpations of the antennæ similar to those which precede copulation. In nature, however, this might not have occured.

In confinement copulation was witnessed. The female apparently copulates but once, as the one observed repeatedly rejected males after having been fecundated. The males, on the other hand, are apparently able to fertilize more than one female, since they make repeated attempts after their first mating.

The tables given above show several instances of longevity among individuals of this species, both in males and in the single female, one individual of each sex living longer than three months. Whether the period of life would be as long under normal conditions of subsistence and expenditure of energy is perhaps questionable, but it seems highly probable that a single female lives sufficiently long to construct several nests of the type described in this paper.

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[6] This difference in size is evidently the general rule. Aberrations have been noticed and one of these is shown in figure 2, where cell No. 2 is larger than No. 1. This condition seems to be exceptional.

Ancistrocerus capra de Saussure.

The habits of this wasp have been recorded briefly by the Peckhams (1900), who describe three successive nests constructed by this species in the mouthpiece of a tin horn. Their observations differ from mine in that they found the duration of the egg stage to be four days instead of two. These authors point out the similarity of the habits of this species to those of the European *A. nidulator* de Saussure, observed by Fabre (1891). The Raus (1918) have published observations on a nest made by *capra* in a woody elder twig, in which the innermost cell was of much greater capacity than the seven (one empty) additional cells, but no mention is made of the sex of the wasps reared from the nest. Observations of Rev. T. W. Fyles, reported by Ashmead (1894), show that this species provisions its nest with larvæ of the larch saw-fly (*Lygæonematus erichsonii* Hartg.) Unfortunately I did not preserve any of the larvæ used by *capra*, but I am almost certain that in this case they were lepidopterous rather than of saw-flies. It seems probable that species of Ancistrocerus do not limit themselves to a particular kind of caterpillar, but avail themselves of whatever desirable food may be abundant.

Nest No. 6. At 3:30 P. M. on June 20, I observed a large Ancistrocerus apparently just selecting her nesting place. She made repeated entrances, coming out each time and flying off for a short distance, apparently carrying nothing. She was possibly making a long distance locality study. Soon she began to bring in mud, out of which she constructed a basal partition at about 7 mm. from the interior end of the tube. During the construction of this partition I took many liberties with the nest, removing the glass tube during the wasp's absence and sometimes failing to get it replaced before she returned. She seemed little disturbed. Once, as she hovered before the window sill where her nest should have been I slowly placed it in front of her and she entered as though nothing had happened. Perhaps as a result of this interference, she abandoned her first partition and started another about 5 mm. from the first. When this was finished the wasp backed out of the tube, turned about and backed in presumably to oviposit, but strangely no egg was laid until half an hour later (5:30 P. M.). At six o'clock she brought in a caterpillar and suspended operations, remaining asleep in the cell all night.

During the building of the partition described above, I removed a small stone which had been resting on the nesting block and placed it a few inches to one side of the nest while the wasp was away. On her return, instead of flying directly to the entrance as she had been doing, she made for a position just beneath the misplaced stone. Discovering her mistake, she soon found her nest by flying about at a few inches from the wall. A little later, while examining the tube during the wasp's absence, I placed the entrance block on the window sill at a short distance from its right position. The wasp returned and entered the hole in the entrance block. Finding nothing behind it, she retreated for some distance, and the nest meanwhile having been replaced, she then entered without hesitation. This would seem to indicate that certain objects, such as the stone, serve as guides to the wasp, but this and further observations show that the wasp is not helpless when such guides are removed, since after once finding her nest in the absence of the stone she apparently made use of other means to locate her nest.

June 21 at 9:15 A. M. wasp No. 6 was carrying in mud. This she deposited and went off again returning with a drop of water shining at her mouth. She was apparently just finishing a partition, for she appeared at the entrance, came out and backed in, remaining within for three minutes to lay an egg. Oviposition finished, she appeared at the entrance and after excitedly waving her antennæ, flew off.

At this time I made a further test of her ability to locate her nest by placing a similar nesting block about five inches away from the original and marking it with the stone which had formerly served as a guide. At 10:00 A. M. the wasp came back, bearing a large green caterpillar; she flew directly to the wrong nest, but did not enter, retreating from it and approaching it several times, finally flying to a tree twenty feet distant. The stone was then replaced on the true nest. The wasp returned, still bearing her prey, tried the false nest as before, but almost immediately went to the right nest and entered.

This wasp was captured for identification as she was about to complete her nest at 1 o'clock (June 21).

Nest No. 7. Another *Ancistrocerus capra* was discovered constructing her nest on the same day at 5 P. M. Two hours later she had made a basal wall of mud, deposited an egg and was resting in the tube.

During the mud-carrying operations of this wasp, I removed the stone which marked her nest and placed it six inches to one side. Returning, she flew directly for a point beneath the removed stone, discovered her error and flew along the wall in a horizontal direction, pausing before another nesting block, similarly located on an adjacent window ledge and similarly marked by a small stone. She hovered in front of this empty nest, still holding the lump of mud she was carrying, then suddenly made a swift flight perpendicularly from the building, turned and made a bee line for her true nest, which she found without delay. The stone was not immediately replaced, but the wasp on subsequent trips entered her nest without hesitation, approaching it, however, in a perpendicular direction, instead of obliquely as she had done before her landmark had been misplaced. When the stone was replaced she continued to enter the nest without confusion.

The second day of this wasp's activities was extremely hot and humid. I had always believed that such a day would be particularly conducive to work with the wasps, and was surprised to find that this individual responded to the heat in much the same manner as her observer, for she remained in her nest the greater part of the day and brought in only three caterpillars, one in the early morning and two in the late afternoon. The following day (June 23) heavy clouds kept off the heat of the sun during the morning so that by ten o'clock four caterpillars had been stored. A half hour later the rim of the closing partition of a second cell had been made. The mid-day heat doubtless delayed the closing of the entrance until about 4 P. M., when the wasp was captured before she had quite finished.

The nests built by these two individuals of *Ancistrocerus capra* were similar to those described for *A. tardinotus*. As mentioned above nest No. 6 had two basal partitions, one 7 mm. from the inner end of the tube and the second about 5 mm. from this. There were four cells, the first, between the two basal partitions, empty; the second, 28 mm. long, was provided with a suspended egg and four caterpillars; the third was 26 mm. in length and had the same amount of provisions with an egg; the fourth cell was 25 mm. long and quite empty, its closing partition, incomplete, was about 12 mm. from the entrance. The entrance was not closed, as the wasp was captured before she had been able to do so. The inside diameter of the tube was 6 mm.

Nest No. 7 contained a tube having an inside diameter of 7.5 mm. Its basal partition was constructed at about 15 mm. from the inner extremity of the tube. The first cell was 25 mm. long and contained its suspended egg and seven caterpillars; the second cell was empty, its length about 40 mm. and at about 8 mm. from its base was a very light rim of cement where the wasp had started and abandoned a partition. The closing partition of this long empty cell was about 12 mm. from the plug which closed the entrance, the latter being incomplete since the wasp was captured during its construction.

I was unsuccessful in rearing the wasps from nest No. 6. The egg in cell No. 1 adhered to the wall of the tube, because of excessive moisture and did not develop. The second egg became detached from its filament, hatched in two days and lived two days longer, attaining a length of about 7.5 mm., when it succumbed to the unfavorably moist conditions.

The single egg in nest no. 7 hatched (June 23) also in two days, after having become detached from its hanging position. On June 28 it had reached a length of 15 mm. and was vigorously feeding on the remnants of its provisions. In feeding it held itself in a curled up position, its back nearly forming a circle, the piece of food held down against its ventral abdominal segments beneath its head. On June 29 it started spinning, but did not finish its cocoon until July 2. Six days later it pupated and on July 24 shed its pupal skin, emerging the next day. In captivity this wasp, a female, lived until August 22, nearly a month after emerging. The lengths of its stages were as follows: egg, 2 days; larva, 15 days; pupa, 16 days.

Ancistrocerus albophaleratus de Saussure.

Two nests built by wasps of this species came under observation. Ashmead (1894) records it as having been bred from an oak gall in Massachusetts.

Nest No. 14. This nest was started July 4 at about 4 P. M. The nest builder was observed rather constantly until July 10, when she was found dead within the entrance of her uncompleted nest. The preceding day had been rainy and may have brought about her untimely death, but the somewhat erratic construction of her nest may indicate that she was at the end of her resources.

Nest No. 21. This nest of *albophaleratus* was commenced July 19 and finished five days later. During a cool, wet day the wasp was inadvertently knocked from her nest, while she was apparently sleeping and lost in the grass. Although she returned the next day, her absence may have given an opportunity for a fly to enter her nest and deposit eggs, the larvæ from which later destroyed the entire nest and its contents.

The tube in which nest no. 14 was built had an inside diameter of 7.5 mm. Its inner end being completely closed, the wasp built no basal partition. The first cell was 18 mm. long and contained about 14 caterpillars; the second, 15 mm. in length, contained only six; the third cell, 16 mm. long, was empty; the fourth cell had a very imperfect basal partition, in which spaces had been left and was 10 mm. long. There was an egg suspended in this cell, but no caterpillars had been provided. It was in this cell that the wasp was found dead. A rim of mud about the periphery of its outer end showed that an attempt had been made to close the cell. Evidently the wasp had been unable to provision this last cell and was in the act of closing it when she met her death.

The tube utilized by the other wasp of this species (No. 21) had an inside diameter of 6 mm. The nest had three cells,the basal partition of the first having been built about 5 mm. from the plug of cotton which stopped the inner end of the tube. Cell No. 1, 30. mm. long, had 13 caterpillars, cell No. 2, 28 mm. long, had seven and cell No. 3, 13 mm. long, contained eight. All were provided with eggs suspended in the usual manner. The entrance to the nest had no closing plug, the outer wall of the third cell being about 12 mm. from the entrance and the space beyond it was entirely vacant.

Only one wasp from these nests reached maturity, a female. The duration of the stages in her life was as follows; egg, 3 days; larva, 16 days; pupa, 13 days. The larva became inactive about six days after hatching and spun no cocoon. The imago lived thirty-five days.

Miscellaneous Notes.

Other nests built by undetermined species of Ancistrocerus were observed during the summer, but with most, because of parasites or other unfavorable conditions, the data obtained are too fragmentary to be of further use than to substantiate the findings on the species treated in more detail. In general the observations on these nests are consistent with what has already been recorded.

Nests started later in the summer (four in number, built Aug. 8, 16, 17, and 22) have a somewhat different history. Instead of pupating a few days after spinning, individuals from these nests still remain as larvæ during the winter and will probably not complete their development until the following June.

Not a few nesting places presented evidence of nests having been started by wasps and abandoned in an incipient stage. In some basal partitions were made, never to be utilized. In two tubes an initial cell was provided with an egg and several paralyzed caterpillars and then abandoned. In both of these, eggs and caterpillars disappeared within a day, and the presence of ants in both leads me to believe that these depredators may have been guilty of the robbery. Whether the nests were abandoned by their builders before the incursions of these ants or whether the desertion was a result of their intrusion could not be determined. The paralyzed caterpillars and the wasp egg would doubtless be attractive to these insects and it is not unlikely that the presence of a few worker ants in a nest would drive the owner away.

Three nests of Ancistrocerus were infested by dipterous larvæ. In one of these the eggs were very evidently deposited in the nest by the adult fly; the others may have been deposited on the caterpillars before they were brought to the nest. In all three nests the behavior of the fly larvæ was the same—they devoured everything. After consuming the contents in one cell they broke through the mud partition and fed on the contents of the next and so on until the entire nest was destroyed. Attempting to rear the adults for identification, I placed the pupæ of these Diptera in glass tubes fitted with tight cotton plugs, thinking to prevent their escape. But the adults were evidently well provided with means for escaping from wasp's nests, for on emerging they worked their ways through the cotton and were lost.

An undetermined species of Chrysidid, which I shall mention elsewhere, was also associated with wasps of the genus *Ancistrocerus* observed during the summer of 1921.

SUMMARY AND CONCLUSIONS.

Observations on the three species of Eumenidæ treated in this paper (*Ancistrocerus tardinotus* Bequaert, *A. capra* de Saussure and *A. albophaleratus* de Saussure) bring out the following facts concerning their biology.

1. These species appear to nest usually in suitable cracks and crevices adapted to their needs.

2. The nests made by these wasps in glass tubes have the following characteristics:

a. Tubes having diameters of from six to eight millimeters were utilized by the wasps.

b. Nests consist of from one to four cells, these apparently varying in length conversely to the diameter of the tube, the inner cells being usually larger than the outer. The cells are separated by partitions of mud which the wasp makes by mixing fine sand and water.

c. The cells are each provided with an egg, suspended by a filament from above and each contains from three to fourteen caterpillars; these are supplied after the egg has been deposited.

3. The caterpillars are paralyzed by the wasp by stinging probably at some point near the thorax.

4. From rather fragmentary evidence it appears that the larger, inner cells contain eggs which are destined to produce females, while the smaller, outer cells contain those which are to become males.

5. There are probably two generations of these wasps annually, the eggs of the first being laid from mid to late June, the adults from them appearing during the first half of July. The eggs of the second generation are laid during the latter part of July and the first of August, the wasps from them hibernating as larvæ and probably emerging in June.

6. From the longevity of certain of these wasps in captivity it is concluded that the females live long enough to construct several nests of the sort described here.

7. The females are apparently guided to their nests by certain landmarks, but are not helpless when such landmarks are removed or distrubed.

8. Dipterous larvæ, Chrysididæ and perhaps ants have been observed as enemies of the species studied.

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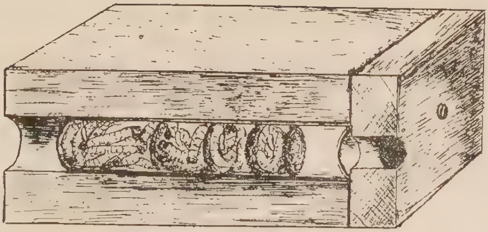

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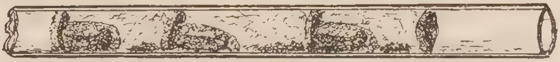

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EXPLANATION OF PLATE IV.

Fig. 1. Longitudinal section of nesting block, showing glass tube in position and nest no. 2 containing four cells, each with its egg and caterpillars. (⅔ natural size.)

Fig. 2. Nest built by *Ancistrocerus* sp. showing three cells with larvæ in cocoons. (⅔ natural size.)

Fig. 3. Egg of *Ancistrocerus* sp. with suspending filament. (This and the next two figures enlarged about fifteen times).

Fig. 4. Same egg as in figure 3, about to hatch.

Fig. 5. Larva (just hatched from egg shown in figure 3) suspended from the shrunken chorion.

BIOLOGICAL NOTES ON PARTHENOGENETIC *MACROSIPHUM TANACETI* LINNAEUS
(APHIDIDÆ, HOMOPTERA)[1]

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The data on which the present paper is based have been collected while I was conducting experiments on *Macrosiphum tanaceti*, in connection with another problem. The work was done at the Bussey Institution during the earlier part of the summer of 1921. A few of the facts brought out in the discussion are somewhat fragmentary, and require more thorough investigation; but, in view of the scarcity of such records of aphid behavior in the literature, they have been introduced here, in the hope that they may help to stimulate further research along these lines.

I. *Ecdysis.* There are no appreciable differences in the behavior of *Macrosiphum tanaceti* during the four successive molts. No attempt, therefore, will be made in the present paper to describe the methods separately for each ecdysis. Preliminary to the process, the nymph ceases to feed for a few minutes, and in the meantime holds with its claws on the surface of the supporting part of the plant. The position of the insect during molting has always been found to be such that the head points toward the ground. The legs are spread far apart, so that the prothoracic pair is directed anterolaterally with reference to the insect's body; the mesothoracic, ectolaterally; and the metathoracic, posterolaterally. The haustellum is held close to the sternum. The subcaudal portion of the abdomen almost touches the surface of the plant. The antennæ are directed posteriorly, and are subparallel to the lateral margin, but diverge at an angle of about thirty degrees above the dorsal surface of the body. A longitudinal mesal rupture then appears at the head, adjoining the base of the clypeus. The insect slowly forces its way through the opening thus made, in the meantime increasing the length of the rent posteriorly along the dorsomedian line of the body, until the caudal margin of the metanotum is reached. The method of formation of the initial rupture has not been observed. Neither has the mechanism of propulsion of the aphid, as it glides by degrees forward, out of the exuviæ, been satisfactorily determined. It is, however, evident that the legs are not of assistance until later in the process. In all probability, the force of expansion of the insect's body itself directs the course of the movement through the slit, this opening furnishing the point of least resistance in the tightly fitting exuviæ. The head naturally goes out first, being nearest the rupture; and the opening enlarges as the more bulky thorax and abdomen pass out. The pro- and mesothoracic legs soon become disentangled, and it is remarkable how quickly the insect is able to spread them apart and use them to help force the rest of the body out. Apparently, sometime before, or during the earlier part of ecdysis, the chitinous coating of the appendages of the future succeeding instar has a chance to harden. The concluding part of ecdysis, when only the caudal portion of the abdomen and a fraction of the metathoracic tibiæ and their tarsi remain in the exuviæ, goes on as slowly as the earlier part of the process. The insect never seems to be in a hurry about extricating itself, and, on the whole, the molting of an aphid is an extremely sluggish operation. Finally, the hind legs are set free, but, even then, the insect continues to remain attached with the abdominal cauda enclosed within the ensheathing exuviæ. The legs sway up and down and the antennæ remain in their posteriorly directed position. Apparently this delay in freeing itself is an important step in the molting process, as it enables the chitinous layer of the body and of the appendages to get dry in the outside air and increase in firmness, until it is safe enough for the insect to turn itself loose. After about five minutes, or so, the fore and middle legs execute a forward crawling motion and the hind legs kick against the exuviæ, the aphid ultimately making its escape in this manner. The entire molting process, from the appearance of the initial rupture to the final escape of the insect, lasts from about twenty to about thirty minutes.[2] The freshly molted aphid is at once able to walk, but is incapable of resuming feeding until about one-half hour, or more, later.

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[1] Contribution from the Entomological Laboratory of the Bussey Institution, Harvard University. No. 199.

One other point may be noted here in connection with ecdysis The layers of the black pigment which in this species give the antennæ, haustellum, wing-pads, legs, cornicles, and abdominal cauda their characteristic piceous color are intimately associated with the chitinous exoskeleton, and are cast off with the exuviæ at each molt. They are then formed anew in the succeeding instar. The freshly molted *Macrosiphum tanaceti* is uniformly light green, except the eyes, which are reddish vermillion. The light green color is due to the presence of characteristic green substance in the fat cells and other body tissues, which shows through the semitransparent cuticle. This coloring matter has been the subject of investigation years ago by various workers, notably by Macchiati (1883), who claims to have found chlorophylloid substances in *Siphonophora malvæ* and in *S. rosæ*, and by Przibram (1906, 1909), who has observed that aphids fed on etiolated leaves of onion plants that have been kept in the dark assume the pale yellow color of the latter, suggesting thereby that the green chlorophyll of the plant probably has some relation to the green substance in the aphid tissue. More recently, Glaser (1917) has reported that by chemical tests he has been able to detect the presence of red pigments in *Pterocomma smithiæ* Monell which seem to be localized in the cytoplasm of the fat cells, and which give color reactions suggestive of anthocyanin found in plants.

The characteristic piceous color of the exoskeleton in the regions enumerated above is restored in less than an hour after molting. How this relatively rapid change in color is brought about is difficult to explain. Two possible conditions suggest themselves: (1) After molting, these pigments, with their definitive dark color, are segregated as such by some very active physiological process; or (2) prior to, or during, molting the future dark pigments are deposited in the form of certain achromatic substances and in the succeeding instar assume their characteristic tint upon exposure to light and to other external stimuli.

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[2] About the same length of time has been observed in *Toxoptera graminum* Rondani by Webster and Phillips (1912).

Janet (1909) has classified in a succinct form the steps involved in ecdysis among insects into four general successive phases. The following quotations from this author are reproduced here for the purpose of comparison and correlation with the foregoing observations and deductions on aphids.

1. "Le décollement de la cuticule ancienne, décollement qui commence généralement dans la région supérieure de la capsule céphalique et se propage vers l'arrière. La cuticule ancienne, décollée, demeure autour du corps sous forme d'une exuvie libre, intacte, et constitue une enveloppe protectrice, momentanément indispensable à cause de la délicatesse de l'épiderme mis à nu."
2. "Accroisement en surface ou transformation du modèle de l'épiderme libéré de sa cuticule."
3. "La formation des premières strates de la cuticule nouvelle, cuticule dont l'apparition rend inutile la protection que fournissait l'ancienne cuticule exuviée."
4. "Le déchirage et le rejet de l'ancienne cuticule."

It appears in the case of the aphids, as well as of other insects, that the above four steps overlap, one into the other. During the detachment of the old cuticle from the insect's body-wall, there undoubtedly occurs simultaneously an increase in surface area of the hypodermal layer. In fact, the stretching effect resulting from the latter cause, together with the steadily augmenting pressure from the developing internal organs, evidently provides the immediate mechanical means for separating the old chitinous from the hypodermal layer. Under the protective cover of the freshly loosened exoskeleton, the new chitinous layer which has been secreted by the hypodermal cells has a chance to develop a firm, although somewhat delicately soft, consistency before the initial rupture appears in the exuviæ. In aphids, the hardening of the newly formed exoskeleton occurs mainly during the lengthy process of casting off the old skin.

Summary of Section I. Feeding ceases a few minutes prior to molting. The head of the insect is pointed toward the ground during the process. The rupture of the chitinous exoskeleton appears first near the base of the clypeus and extends dorsomedially to the posterior margin of the metanotum. The entire molting process, from the formation of the initial rupture until the aphid extricates itself, lasts about thirty minutes. It is able to walk soon after escaping from the exuviæ, but is incapable of resuming feeding until about one-half hour, or more, later.

The characteristic piceous color in certain parts of the body is either located in, or intimately associated with, the chitinous exoskeleton, and is cast off at each ecdysis, reappearing, however, in the newly formed integument in less than an hour after molting. The light green color which characterizes the larger portion of the body is due to certain substances in the fat cells showing through the semitransparent cuticle.

The new chitinous layer is deposited sometime before the molt. It has a chance to harden during the lengthy process of casting off the old exuviæ.

II. *Locomotion.* The principal and usual method of locomotion, even in alate individuals, is by walking. The wings are used very rarely, and perhaps in connection only with migration from one plant to another when the aphids on a particular host begin to become overcrowded or when the supply of plant sap becomes inadequate. The flight is very feeble, and it is doubtful if the insect can traverse any considerable distance by this means alone.

In walking, the antennæ are directed anteriorly, describing in that position an angle of about forty-five degrees. They continually sway obliquely in alternate turns in an entodorsal and ectoventral direction. The rate of this movement is apparently correlated proportionately with that of the legs; and under ordinary conditions, when the insect is not disturbed, or otherwise excited, the antennæ sway one hundred and twenty times in one minute. This figure has been found to be approximately correct for all instars.

After numerous attempts at following the movements of the legs while the aphid is walking, I have come to the conclusion that they do not follow any regular schematic sequence. Further, it appears that no two legs move synchronously in the same direction, and that there is no definite rule as to the order in which the legs follow one another. The time intervals between successive steps, irrespective of the sequence of leg movements, appears to be maintained at a uniformly similar rate for a given speed.

Summary of Section II. 1. The principal method of locomotion, even in alate individuals, is walking, the feeble wings being used rarely.

2. The rate of diagonal swaying of the antennæ and the rapidity of walking appear to be correlated, the movement of the former being in direct proportion to that of the latter.

3. The movement of the legs do not follow any regular schematic sequence, although the time intervals between successive steps appear to be uniformly maintained in a given speed. No two legs move synchronously.

III. *Feeding Habits. Macrosiphum tanaceti* has been known to occur only on *Tanacetum vulgare* Linnaeus. This species of aphid apparently has no secondary host plant.

No attempt will be made in the present work to describe the mechanical and physiological relation of the mouth-parts to the plant tissue during the process of feeding. Considerable work has been done in connection with this problem in comparatively recent years, notably by Büsgen (1891), and by Zweigelt; the latter author has been working on this and related subjects during the past decade. Zweigelt (1915) suggests the following three possible means by which suction of plant sap is accomplished in aphids.

"1. Eine bestimmte Zelle wird angestochen und ohne Verletzung der äusseren Hautschicht des Protoplasten ausgesaugt; 2. die Aussaugung bestimmter Zellen erfolgt während deren vollständiger Durchbohrung; 3. die Aussaugung geht zufolge einer dem Speichel innewohnenden starken osmotischen Saugkraft bei interzellularem Stichverlauf ohne mechanische Verletzung der Zellen vor sich."

Macrosiphum tanaceti feeds on the growing regions of the stem, on which different instars of this species are found in large numbers from early spring until late in the fall in Boston and vicinity. The more succulent portions of the petioles are also feeding places for the later nymphal instars and the adults, although they are found here only occasionally. While the aphid is feeding, its head points toward the ground, the antennæ are directed lateroposteriorly with reference to the body, and the legs are spread apart. The haustellum is at right angles with the body or inclined somewhat anteriorly. The labium, which serves as the sheath for the rest of the mouth-parts, except the labrum, remains straight. No posterior bending is observed at the point of junction of any two labial segments, which is a characteristic feeding habit of the members of a closely allied order, the Heteroptera. The latter group resorts to this contrivance in order to enable the setæ to penetrate deeper into the plant tissues. In *Macrosiphum tanaceti* the tips of the setæ apparently do not go far beneath the epidermis of the plant, perhaps reaching only a small portion of the cortical layer. This supposition is based on the fact that in all the specimens examined while in the act of feeding it was found that the setæ protrude less than a millimeter beyond the distal end of the labial sheath.

The position assumed by the insect while feeding is interesting. It is not easy to see why the insect should prefer to remain in that seemingly uncomfortable posture in which the abdomen is situated uppermost. The following experiments were conducted in order to find out the possible explanation for this peculiar habit:

Growing tips of *Tanacetum vulgare*, with numerous tansy aphids in different instars feeding on them, were carefully bent down without injuring the plants and were made to remain in this position by fastening them with strings. In this way, the aphids, without being disturbed, are reversed in their position, now with the head uppermost. These experiments were performed in the morning when it was still cool, at noon, when the sun was very bright and the temperature was about 32° C. (90° F.) and in the evening when it was almost dark. The results in all cases have been found to be identical: The aphids sooner or later return to their former position, that is, with the abdomen uppermost and the head directed toward the ground. The degree of ability to orient itself in this manner apparently differs with the age and morphological characters of the individual. The alate adults turn around almost instantly after their former position is reversed. The nymphs in the first instar are the slowest to respond to the treatment. The later nymphal instars of the future alate and apterous individuals and the apterous adults do not react at once, as in the case of the winged adults, although the repsonse takes place much more quickly than in the first-instar nymphs.

The following interpretations are offered for the foregoing behavior: the tansy aphid, like the parthenogenetic forms of the other species of this family, feeds practically all the time. It is interrupted in this activity only when it changes its feeding location, after the supply of food material in a given part of the plant becomes temporarily used up. In a healthy plant, where there is an abundance of succulent tissue at the growing region, this change in location takes but a short time. The feeding operations, of course, require that the aphid remain stationary in one poistion during the process, and, consequently, it has to stand still almost all the time. Now, under these conditions, prolonged exposure to the direct rays of the sun, especially at midday, when they are very intense, is undoubtedly uncomfortable, if not ruinous, to the eyes of the aphids. The tansy plants generally grow in unsheltered places and the growing tips on which the aphids feed are fully exposed to the sun. The habitual position of *Macrosiphum tanaceti* is probably an adaptation to that environmental condition. By locating itself on the plant in such a way that the aphid's head is directed downward, the rays of bright sunlight from above do not strike the eyes directly. With this view in mind, however, it is difficult to find an explanation for the maintainance of the same behavior by the insect in the morning, when the rays of light are not so intense, and in the evening when it is almost dark. One probability is that the heliophobic reaction of the aphid has brought about secondary effects which cause the insect to assume this position irrespective of the immediate presence of the causative stimulus.

One other explanation may be offered here: The aphid possibly assumes this position for mechanical advantage, in the way of bringing about optimum efficiency in the functions of the sucking mouth-parts, and of minimizing the strain on the muscles of the legs and other parts of the body which is occasioned by the insect's having to remain in one position for considerable lengths of time while feeding.

The fact that the aphids turn around and resume feeding in the reverse direction with respect to the plant when the tips of the tansy on which they are situated are bent indicates that this behavior of *Macrosiphum* has not been brought about as an adaptation to any peculiarity in the structure of the host.

The characteristic feeding position of *Macrosiphum tanaceti* has also been observed by me in other species of *Macrosiphum.* It is interesting to note that the aphids of other genera which I have studied[3] do not seem to exhibit this peculiarity. They almost all indifferently assume any position while feeding. It may be mentioned, as a possible explanation of this difference in behavior, that these other aphids generally feed on the nether surface of broad leaves, or are otherwise protected from the direct rays of the sun. Thus the main stimulus which, as I have suggested above, is probably responsible for the characteristic position of the *Macrosiphum* species is suppressed in the case of the other aphids.

Summary of Section III. 1. *Macrosiphum tanaceti* appears to be confined to a single host plant, *Tanacetum vulgare.* From early in the spring until late in the fall in Boston and vicinity, this aphid in diffierent instars is found feeding on the more succulent portions of the plant, principally on the growing regions of the stem.

2. The head of the insect is directed toward the ground

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[3] Anoecia, Lachnus, Longistigma, Drepanaphis, Drepanosiphum, Myzus, Eriosoma, unidentified aphids on *Berberis vulgaris* Linn., *Celastrus scandens* Linn., *Lythrum salicaria* Linn., *Sherpherdia (Elaeagnus) argentea* Nutt., and *Viburnum* sp., and others.

during feeding, as in ecdysis, which has been previously described. One or both of the following explanations may account for this peculiar behavior: (1) In order to avoid the rays of the sun from streaming directly into the eyes. (2) For mechanical advantage, the feeding apparatus perhaps attaining its maximum efficiency or the strain on the muscles being probably minimized when the aphid assumes this position. The second explanation is purely speculative. This characteristic position is evidently not an adaptation to any peculiarity in the structure of the host.

3. The setæ of this aphid apparently do not penetrate very deeply into the plant tissue.

IV. "Death-Feigning." The habit of dropping to the ground when disturbed and remaining motionless for a time is a very peculiar characteristic which is exhibited by many species of *Macrosiphum*.[4] *M. tanaceti* responds readily in this manner and on reaching the surface of the ground, the insect behaves in either of the following two ways, depending on its position after it drops: (1) If it lands on its ventral side, it simply stands on its legs and remains motionless in this attitude. The antennæ are directed posteriorly. (2) If it lands on any part of the body other than the ventral side, the legs are folded so that the tibiæ are also directed posteriorly and the insect remains perfectly quiet.

The nymphs of the first instar do not seem to have the ability of "death-feigning" to any marked degree. They are practically the only ones that remain on the plant, after the latter is jarred and individuals of the second and later instars drop to the ground. The adult individuals always regain their standing position very quickly and remain in this position, no matter which portion of the body touches the ground first. The wings remain folded and the insect does not seem to use them as it falls.

The biological significance of this peculiar behavior has been the subject of discussion and speculation by various workers who have observed it in other groups of insects, notably by Fabre on *Scarites gigas* Fabricius (Coleoptera); by Holmes on *Ranatra* sp. (Heteroptera); and by Rabaud and by Bohn on several orders (Bouvier, 1919, pp. 79-89). In *Macrosiphum* the habit of dropping to the ground and remaining motionless for a time is evidently a means of eluding a pursuing enemy.

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[4] In my own work, I have not come across a single species of *Macrosiphum* which does not exhibit "death-feigning." However, Dr. A. C. Baker, of the Bureau of Entomology, U. S. Department of Agriculture, in a letter dated at Washington, D. C., January 18, 1922, informs me that there are some *Macrosiphum* species which do not possess this habit. He further mentions the interesting fact that "death-feigning" is not confined to *Macrosiphum*, for this peculiarity is also met with in the Callipterina.

Summary of Section IV. Many species of *Macrosiphum* possess the habit of "death-feigning" when disturbed.

2. The habit is exhibited by *Macrosiphum tanaceti* in all of its stages, except in the first instar.

V. Parturition. At birth, the caudal portion of the nymph appears first at the vaginal slit. The antennæ are directed posteriorly and closely appressed to the body walls. The legs and cornicles are also in the same condition, the appendages thus following the general contour of the body. The tarsi of the metathoracic legs are in intimate contact with each other, forming at the caudal portion of the abdomen a conspicuous acutely subconical projection. The color of the nymph at birth resembles that of the freshly molted nymph or adult. The body and appendages are uniformly light apple-green and glossy, and the eyes are reddish vermillion. The enveloping membrane covering the young at birth, which has been described by Webster and Phillips (1912) in *Toxoptera graminum* Rondani, by Baker (1915) in *Eriosoma lanigerum* Hausman, and by other authors in other species of aphids, has also been observed by me in *Macrosiphum tanaceti.* The results of the present work agree with Baker's account in that the envelope ruptures while the nymph is partially extruded from the vaginal slit of the mother. The nature of this membrane is still in question; although, from my observations on *M. tanaceti*, I am led to believe that it probably arises from the follicular epithelium, which persists to this stage without degenerating. A more detailed discussion of this subject will be given in a later paper on aphid embryology which I am publishing. If my observations, therefore, are correct, this envelope is not a homologue of the vitelline membrane of the eggs of amphigonous aphids, as Webster and Phillips have claimed, since the latter membrane arises as a secretion of the egg-periplasm, and has no direct relation to the follicular epithelium.

The extrusion of the nymph from the vagina, from the time the caudal portion of the abdomen of the former begins to protrude until the entire body is exposed, takes about five or ten minutes. The insect remains in the condition described above, attached by the anterior margin of the head and the bases of the antennæ to the external opening of the mother's vagina for about ten or fifteen minutes. At the end of this time, the young insect has dried its skin well enough to set the appendages free from their attachment to the body. A waving motion of the antennæ and of the legs then ensue; but the nymph does not seem to struggle to make its final escape. After about five more minutes, the chitinous exoskeleton has probably hardened sufficiently, and the mother then executes two or three sudden peristaltic movements of the abdomen, which set the young nymph free. The newly born aphid usually remains in close proximity to the place where it is deposited by the mother. In about fifteen or twenty minutes after birth the nymph begins feeding, and by this time also the characteristic colors of the body and appendages become evident.

The position of the mother during parturition is the same as that described in connection with her feeding habits. The abdomen is situated uppermost and the head directed toward the ground. In fact, parturition goes on simultaneously with feeding, apparently without in the least interfering with the latter process.

Summary of Section V. 1. At birth, the young makes its appearance with the caudal portion of the body first.

2. After extrusion from the vagina, the nymph remains attached by the anterior margin of its head to the vaginal slit of the mother until the exoskeleton of the young hardens. The process requires about ten to fifteen minutes, when the nymph finally becomes separated from the mother.

3. At birth, the nymph is covered with a membraneous envelope which usually ruptures when the former is partially extruded through the vaginal slit. The nature of this envelope is still in question. I infer from my own observations on *Macrosiphum tenaceti* that the membrane arises from the egg-follicle, which apparently does not degenerate.

4. The nymph begins to feed in about fifteen to twenty minutes after birth.

5. The position of the mother during parturition is the same as in feeding. Parturition apparently does not interfere with the latter process.

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NOTES ON DISTRIBUTION AND HABITS OF SOME OF THE BIRD-FLIES, HIPPOBOSCIDÆ.

By Charles W. Johnson,

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The following notes on this interesting group of flies have been brought together in the hope of thereby encouraging ornithologists to observe more closely the occurence of these insects on the various species of birds. While the wide distribution and great diversity of hosts frequented by one species seems somewhat at variance with the distribution of other insects as well as their hosts, it is impossible with the limited material and data at hand to arrive at any other conclusion regarding the species. Highly specialized forms always lose many of the distinguishing specific characters present in the species of the higher groups less restricted in their habits. Living as these flies do under similar and uniform conditions, notwithstanding their wide distribution, they would naturally show but little variation.

The occurence of the same species of fly upon non-migrating birds confined both to the tropical and boreal regions would indicate that they are naturally transmitted from one to the other by the migratory species; and the interesting example of phoresy recorded below shows how the various species of the wingless Mallophaga are also distributed.

One of the peculiar habits of these flies, and one which probably accounts for so few of them being taken by ornithologists, is that they are rarely seen while the bird is warm, but as the dead bird becomes cold they dart from it as if terror-stricken at losing their host, for if another cannot be found soon, it probably means death. If in this quick flight they happen to alight on one's clothes, there is a possibility of capturing them, if caught firmly between the thumb and finger, for their smooth, flattened bodies slip easily through one's fingers and when once they escape they are rarely seen again, as they dart into any little crevice that offers protection.

Their method of reproduction admits of no great increase, producing but one large egg at a time, which develops into a peculiar larval condition within the parent, and pupating at birth. The decrease in the number of birds will undoubtedly diminish these flies, which deserve a great deal of careful biological study, for our knowledge of the group is still very inadequate.

The following records are in part based upon specimens in the Museum of Comparative Zoölogy, Boston Society of Natural History, and the author's collection.

Ornithoica confluenta (Say).

Ornithomyia confluenta Say, Jour. Acad. Nat. Sci. Phila., III, 103, 1823.
Ornithomyia confluens Wied., Auss. Zw., II, 611, 1830.
Ornithomyia vicina Walker, List Dipt., IV, 1144, 1849.
Ornithoica confluenta Speiser, Ann. Museo. Civ., XX (2d ser.) 558, 1899; Ent News, XVIII, 103, 1907.
Ornithoica confluens Aldrich, Catl., 655, 1905.

Say recorded this species from "*Ardea candidissima,*"—Snowy Heron (*Egretta candidissima*). No locality is given, and it may have been collected in "Pa.," "or west of the Missouri River." Wiedemann gives Pennsylvania. Walker's *O. vicina* was from "Jamaica, on *Ephialtes grammicus*" [Jamaica owl] (Gosse Coll.); also on *Psittacus leucocephalus.* Nothing further regarding the habits of this species appeared until 1878. Osten Sacken in his catalogue of Diptera, page 263, says: "*Ornithomyia confluenta* Say will, I suppose, form a new genus, on account of its peculiar venation. An apparently diffierent species of the same group was found by Mr. Wm. Holden on *Accipiter fuscus* near San José Cal." A study of this specimen in the Museum of Comparative Zoölogy shows no character to separate it from specimens referable to *O. confluenta.* There are also in the above Museum four specimens from Cuba, one collected by Pocy and three by Gundlach. There is in the old collection of the Boston Society of Natural History a specimen marked "Mass."

The latest and most interesting capture of this species was that of two specimens by Mr. W. S. Brooks at Wilson Mills, Oxford County, Maine, Nov. 4, 1921, from the Canada Jay

(*Perisoreus canadensis*). It was these specimens from a non-migratory bird of Canadian life-zone that led to a study of this species and the finding of an almost parallel case in the distribution and habits of *Ornithomyia anchineuria*. Some specimens are slightly darker than others and vary from 2 to 2.5 mm. The wing is shown in figure 1, and the following species in figure 2.

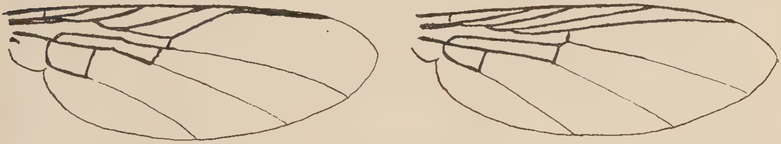

Fig. 1. Wing of *Ornithomyia confluenta* at left; of *O. anchineuria* at right.

Ornithomyia anchineuria Speiser.

Ornithomyia pallida Say, 1823, *nec* Latreille, 1811.
Ornithomyia anchineuria Speiser, Zeitschr. f. Hym. u. Dipt., 1905, V, 348.

Say's type was taken on the Bluebird, "*Sylvia sialis.*" No locality is mentioned. Wiedemann gives "Pennsylvania," and in Aldrich's Catalogue is "West of the Mo. River." In Smith's Insects of New Jersey, 1899, p. 699, I recorded it from the Bobolink or Reed-bird (*Dolichonyx oryzivorus*) and Red-winged Blackbird (*Agelaius phœniceus*). The specimens were collected by Mr. Charles Liebeck along the Delaware River below Philadelphia, Aug. 19 to Sept. 27, 1892-97. A specimen was taken on a Hermit Thrush (*Hylocichla guttata pallasii*) at Clifton, Pa., Oct. 19, 1897, by Mr. C. A. Voelker. A specimen was also obtained from a Robin (*Planesticus migratorius*) at Southbridge, Mass., Aug. 18, 1914, by Mr. S. W. Bromley, and from a young Junco (*Junco hyemalis*) at Woodstock, Vt., Aug. 1911, by Mr. A. P. Morse. In the Museum of Comparative Zoölogy is a specimen from the Red Crossbill (*Loxia curvirostra minor*) collected at North Bay, Onatrio, Sept. 7, 1896, by G. S. Miller, Jr., and from the Catbird (*Dumetella carolinensis*), at Worthington, Mass. Another specimen in the same Museum was collected by Mr. W. S. Brooks at Ellis Bay, Anticosti Island, Sept. 3, 1919. from a new Jay (*Perisoreus barbouri*) allied to the Canada Jay, This specimen has attached to it two Mallophaga, one on each side of the abdomen just back of the posterior edge of the first segment; in the dried specimen they extend beyond the end of the fly's abdomen, with the ends of the Mallophaga touching each other. It is an interesting example of phoresy and shows how many of the Mallophaga are probably distributed.[1]

On Aug. 29, 1921, Mr. A. B. Fuller obtained two specimens from the Savannah Sparrow (*Passerculus sandwichensis savanna*) at Essex, Mass. One of the flies had attached to it a pupa, black and polished in appearance, but when enlarged twenty-five diameters it shows an irregular mosaic-like pattern. At one end there is a slight contraction, forming four or five slight nodes. Its length is 2.5 mm., while the total length of the dried fly is 4 mm. In a recent "Annotated List of the Diptera or Oregon," by Cole and Lovett (Proc. Cal. Acad. Sci., 1921, 4th ser., XI, 344), this species is recorded from "Upper Alsea Valley, Benton Co., on Steller's Jay." Coquillett records it from Washington D. C., to California.

Except for size, I see little to separate this species from the European *O. avicularia* Linn., and it is probably what Van der Wulp had before him when he recorded the latter from Wisconsin (Tijdsch. v. Ent., XII, 80, 1869). As Coquillett suggests (Ent. News, XVIII, 290, 1907), it may represent one holarctic species. The *O. avicularia* also frequents many species of birds, including hawks, owls, woodpeckers, herons, ravens, jays, partridges, peacocks, crossbills, sparrows, skylarks etc.

Olfersia albipennis Say.

It is a question whether *O. albipennis* and what we are calling *O. ardeæ* are not one and the same species, but whether it is the same as the European species is still another question. When the light strikes the wings at a certain angle, especially when they overlap each other, they are often decidedly whitish in color, hence Say's name. As it is an older name than *O. ardeæ*,

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[1] This specimen was recorded by Nathan Banks in Psyche, Vol. 27, p. 20, 1920, and by W. L. McAtee in Ent. News, Vol. 33, p. 20, 1922. The bird however was not mentioned.

I am using it for the American species. It has been taken from the following species of birds:

Great Blue Heron (*Ardea herodias*) T. Say.

Black-crowned Night Heron (*Nycticorax nycticorax*). Alston, Boston, Mass., Aug. 1, '12; Hampton, N. H., May 13, '17 (S. A. Shaw); Delaware River, below Philadelphia, Oct. 15 '96 (C. Liebeck).

Little Blue Heron (*Florida cærulea*). Bristol Isl., Delaware River (Fowler).

White Heron or Egret (*Herodias egretta*). St. Augustine, Nov. 8,'87.

American Bittern (*Botaurus lentiginosus*). Delaware River below Philadelphia, Sept. 13-Oct. 12,'85 (C. Liebeck).

Least Bittern (*Ixobrychus exilis*). Delaware River below Philadelphia, Sept. 18, (C. Liebeck).

Olfersia americana (Leach)

This species is known to frequent the following birds:

Great Horned Owl (*Bubo virginianus*). Wenham, Mass., Dec. 2,'10 (Dr. J. C. Phillips), Dover, Mass., Dec. 24,'94 (A. P. Morse), San José, Cal. (W. Holden).

Barn Owl (*Aluco pratincola*). San José, Cal. (W. Holden).

Long-eared Owl (*Asio wilsonianus*). Hampton, N. H., Apr. 9, '09 (S. A. Shaw).

Barred Owl (*Strix varia*). Framingham, Mass., Nov. 1,'10 (C. A. Frost).

Screech Owl (*Otus asio floridanus*). St. Augustine, Fla. (C. W.J.)

Western Screech Owl (*Otus mccallii*). Calif. (M. C. Z).

Red-shouldered Hawk (*Buteo lineatus*). Wenham, Mass., Aug. 14,'14 (J. C. Phillips), Sherborn, Sept. 21,'98, (A. P. Morse); Dunmore Lake, Vt. (C. E. Brown).

Red-tailed Hawk (*Buteo borealis*). Illinois (M. C. Z.).

Broad-winged Hawk (*Buteo platypterus*). Texas (G. H. Ragsdale).

Pigeon Hawk (*Falco columbarius*). (B. S. N. H.).

Ruffed Grouse (*Bonassa umbellus*). Liberty Hill, Conn., Oct. 1896 (O. Bangs).

Olfersia sp.

From Chuck-wills-widow (*Antrostomus carolinensis*), St. Augustine, Fla. (C. W. J.).

Ornithoctona erythrocephala (Leach)

This has been found on the following species of birds:

Red-tailed Hawk (*Buteo borealis*). Cuba (M. C. Z.).

Broad-winged Hawk (*Buteo platypterus*). Cuba (M. C. Z.).

Sparrow Hawk (*Falco sparverius*). Porto Rico (Coquillett).

Ruddy Quail-dove (*Geotrygon montana*). Holguin, Cuba (M. C. Z.).

Yellow-crowned Night Heron (*Nyctanassa violacea*). Dominica, May 25,'01 (O. Bangs).

Pigeon Hawk (*Falco columbarius*). Metis, Quebec, collected by L. M. Terrill.

The last record, received through Mr. Albert F. Winn, is especially interesting. Although Osten Sacken recorded this fly from Quebec, this is the first record of a host north of the West Indies. Mr. Terrill captured the hawk on her nest and seven specimens of the fly were taken. Since writing the above Jos. Ouellet informs me that he has taken this species on the American Bittern, near Montreal, Aug. 1902.

Pseudolfersia fumipennis (Sahlberg)
(*P. maculata* Coquillett).

From the Fish Hawk or Osprey (*Pandion haliætus carolinensis*). Cape May, N. J., Aug.; Lahaway, N. J., Apr. 1 (J. T. Brakeley); St. Augustine, Fla. (C. W. J.); Sand Point, La., and Cuba (Mus. Comp. Zool.); Bald Eagle (*Haliaeetus leucocephala*). Hampton, N. H., May 17,'05 (S. A. Shaw); and Loon (*Gavia immer*). Wisconsin (Coquillett).

Pseudofersia spinifer (Leach)

Taken on the Florida Cormorant (*Phalacrocorax auritus floridanus*) at Great Sale Key, Bahams, July 17,'05, by Dr. G. M. Allen. A widely distributed species of the tropics, frequenting the Man-o'-War-Bird (*Fregata aquila*), Gannets and Black Vulture.

NOTES ON NEOTTIGLOSSA TRILINEATA KIRBY (HEMIPTERA, PENTATOMIDÆ)[1]

By Roland F. Hussey

In Richardson's "Fauna Boreali-Americana" (Vol. 4, 1837, p. 276, pl. vi, figs. 6, 6a), W. Kirby described and figured a *Pentatoma trilineata*, from one specimen "taken in the road from New York to Cumberland House" [Saskatchewan], and proposed for it a new subgenus, *Neottiglossa*, which he characterized, in the following words:

"*Nose* shorter than the cheeks. *Bed of the promuscis* elevated on each side at the base.

"In the typical *Pentatomæ*, the part which I regard as analogous to a *nose* is of the same length with the two lateral lobes of the front, and the base of the cavity in which the promuscis reposes when unemployed is not so elevated."

Whatever may be said of this generic diagnosis, whose incompleteness led to the redescription of the genus under different names by Dohrn (1860) and by Fieber (1861), Kirby's description of *Pentatoma trilineata* serves amply for the identification of the species, and it is surprising that it has not been better understood. Dallas (List of Hemip., i, 1851, p. 224) records the species from Hudson's Bay and from Nova Scotia. Uhler (Proc. Bost. Soc. Nat. Hist., xiv, 1871, p. 96) placed *trilineata* as a synonym of *Neottiglossa undata* Say, in which he was followed by Stål (Enum. Hem., ii, 1872, p. 18). A few years later, Uhler (Bull. U. S. Geol. Geogr. Surv., iii, 1877, p. 401) separated the two species, recording *trilineata* from Dakota, British Columbia, California, Nebraska, Canada, and the region of the Mackenzie River, and stated that *trilineata* differs from *undata* "in being larger and more robust and blunt anteriorly, the head entirely black and more coarsely punctate, the venter more widely black, and the femora much more invaded with black." Forty-five years have elapsed since Uhler published these notes, yet no one has given us any further information regarding Kirby's species.

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[1] Contribution from the Entomological Laboratory of the Bussey Institution, Harvard University, No. 200.

Among some Hemiptera collected in northern Michigan by Mr. S. Moore of Detroit, recently submitted to me by the Museum of Zoölogy of the University of Michigan, there is one specimen which I refer without hesitation to *Neottiglossa trilineata*. It agrees well with Kirby's original description, differing only in its slightly smaller size (5½ mm. as compared with 3 lines) and in the markings of pronotum and scutellum; but these differences are no greater than may be found in a series of *N. undata*. The specimen before me differs more considerably from Kirby's figures, but these agree neither with each other nor with his description, for in one figure the lateral margins of the pronotum are represented as concavely sinuate, and in the other as straight and concolorous, while the description reads "Prothorax..with the lateral margin..white."

Neottiglossa trilineata, as I identify it, differs from *N. undata* in its darker coloration anteriorly, in the more obtuse apex of the head, in the more broadly flattened pronotal margins, in antennal structure, and in the form of the ventral abdominal segments. Since the species has been so little understood by American entomologists, I have thought best to give a full description of the specimen before me, together with figures illustrating some of the characters by which it differs from *N. undata*.

Head, black, a little bronzed, somewhat shining, deeply and closely punctate, the punctures somewhat finer on the base of the vertex. Sides of head subparallel for a short distance before the eyes, thence concavely sinuate to a point beyond the middle of the tylus, thence straight and converging at an angle of about 110°; extreme lateral margin very lightly reflexed; apex of head slightly but distinctly emarginate. Head, seen in profile (Fig. 1, A), less abruptly deflexed than in *N. undata* (Fig. 1, B), and the apex less acute. Ratio of lengths of antennal segments 19:23:20:35:45 (in *undata* the ratio of segment II to segment III is 23:17); the three basal segments yellowish, the third darkened toward the apex and on the sides, fourth and fifth segments black. Rostrum nearly reaching the hind coxæ, apical segment piceous.

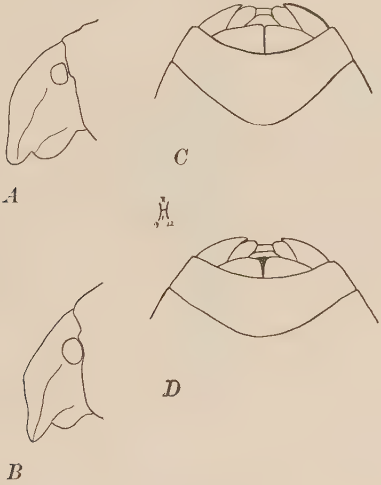

Fig. 1.—A, head of *Neottiglossa trilineata*; B, head of *N. undata*; C, Apical ventral segments of *N. trilineata*; D, ventral segments of *N. undata*.

Pronotum black and closely punctate on the anterior half, obscure testaceous and more sparsely punctate on the posterior half; median line and a small irregular spot behind each callosity yellow. In the specimen before me the median line is obsolete behind the middle of the disc. Lateral margins straight, white, impunctate, broader than in *N. undata*; when viewed from above, there appears to be a narrow black line along the extreme edge, but this is not visible when the pronotum is viewed from the side. Anterior and humeral angles as in *N. undata*; postero-lateral margins a little more oblique and the posterior angles less broadly rounded than in that species.

Scutellum testaceous, sparsely punctate with black, the basal angles impressed, black, the apex with a piceous spot. Median line yellow, extending back from the base for about two-thirds the length of the scutellum, suddenly abbreviated; a transverse yellowish line crosses it at the middle of the scutellum and joins at each side a sublateral line which extends forward to the base of the scutellum; all these lines are faintly margined with piceous, and form a distinct trident-shaped marking. Base of the scutellum between the arms of the trident infuscated or piceous, and more densely punctate than the remainder of the scutellum.

Hemelytra testaceous, sparsely black punctate, with two piceous spots on the apical margin of the corium, one near the inner angle, the other at the end of the cubitus. Membrane white.

Abdomen black above, connexivum white. Beneath bronze-black, closely punctate; coxal cavities and legs yellowish, the femora spotted and lined with black, the tibiæ with short black lines on the distal half of the anterior and posterior faces, the third tarsal segment piceous. Sixth ventral segment more produced anteriorly (♀) (Fig. 1, C) than in *N. undata* (Fig. 1, D).

Length, 5½ mm.

Redescribed from one female taken on the beach of Lake Michigan (in wash-up?) near St. Ignace, Mackinac County, Michigan, May 31, 1921 (S. Moore), and deposited in the Museum of Zoölogy of the University of Michigan.

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